

# **Development of a Comprehensive Decision Making Framework for Power Projects in New South Wales (NSW)**

**AYSE TOPAL**

A dissertation submitted to the University of Technology, Sydney in fulfilment of  
the requirements for the degree of Doctor of Philosophy (Engineering)

**Energy Planning and Policy Centre  
Faculty of Engineering and Information Technology  
University of Technology, Sydney**

**2014**

## **Certificate of Authorship**

I certify that the work in this thesis has not previously been submitted for a degree, nor has it been submitted as part of the requirements for a degree, except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate

---

## **Acknowledgements**

There are a number of people I would like to express my sincerest gratitude, who have supported me during my Ph.D. course.

Firstly, I would like to sincerely thank my supervisor Prof. Deepak Sharma for his support, guidance and encouragement during the entire time of my PhD. His assistance during the entire time has provided me with an invaluable opportunity to finish my PhD course.

I would like to express my gratitude to Mr. Ravindra Bagia, my co-supervisor, for providing guidance during my study.

I would like to thank Dr Tripadri Prasad, for their guidance that helped to improve this study.

I would like to give my special thanks to the Ministry of Education (MOE) from Turkey, where I received scholarship for my study. I also would like to thank The Faculty of Engineering and Information Technology (FEIT) for financial support for the last years of my study.

I would like to thank graduate students at University of Technology, in the Energy Planning and Policy Program for their friendships, particularly, Nagarajan, Muiyi, Pornwan, Jasmin, Kristy, and Garima.

To the former Ph.D. researchers, particularly Dr. Suwin Sandu, Dr. Reza Fathollahzadeh A., Dr. Debborah Marie Marsh, and Dr Tien Minh Do in the Energy Planning and Policy Program, I really appreciated your support and sharing in our research field.

This list would be incomplete without my family; I thank my mother Nejla, brothers A. Said and Ethem, for being supportive, encouraging and patient during my study.

## **Abstract**

In the backdrop of emerging concerns about sustainability, the contribution of electricity generation to sustainability, the complexity of power projects, and the narrowness of existing decision approaches for selecting power projects – this research develops a comprehensive decision-making framework that can be applied to select power projects for meeting future electricity needs in NSW. This framework is based on Multi-Attribute Decision Analysis (Analytical Hierarchy Process). This framework will assist with complex decisions regarding projects typified by multiple objectives, multiple decision makers, multiple attributes, conflicts, and socio-economic concerns.

The appropriateness of this framework is established in this research in terms of its ability to assist with project choices (from among several alternatives), to meet medium (2035) and long term (2050) electricity needs of NSW, in a sustainable manner. The backdrop for the application of this approach is provided by five scenarios, representing alternative technological pathways, energy & environmental and socio-political settings. Fourteen attributes, reflecting major areas of concern relating to economic, environmental, technical, and socio-political issues are considered, guided by literature review and expert opinion.

The overall ranking for each alternative is developed on the basis of, first, assessing the economic, environmental, and social impacts of the alternatives; second, incorporating decision makers' (expert) preferences for selected attributes, through a pair-wise comparison of various attributes; next, developing a weighted average across all attributes. These individual scenario rankings are then used to compare alternatives represented by various scenarios.

The analysis suggest that, overall, the BAU scenario, representing a continuation of existing trends in generation-mix is likely to be the most detrimental scenario for achieving sustainable outcomes in NSW, as it will result in highest levels of levelized cost, GHG emissions, total waste, air pollution, visual impact, water use,

resource (fuel) use, severe accidents; and lowest levels of new jobs, and political and social acceptance. The best option in the medium term (2035) for NSW will be the HR-1 scenario (40% share of renewables, with nuclear), as it will result in the highest levels of new jobs, political and social acceptance; and lowest levels of levelized cost, GHG emissions, total waste, air pollution, resource (fuel) use. The best option in the long term (2050) for NSW will be the HR-2 scenario (80% share of renewables, without nuclear), as it will result in the highest levels of new jobs, political and social acceptance; lowest levels of total waste, water use, severe accidents; and moderate levels of levelized cost, air pollution, water and resource use. It is interesting to note the change of preference from HR-1 scenario in the medium term, to HR-2 scenario in the long term, as informed by trade-offs between various attributes. The above insights clearly demonstrate the usefulness of the proposed framework for making complex decisions about power projects.

## TABLE OF CONTENTS

<b>Certificate of Authorship.....</b>	<b>I</b>
<b>Acknowledgements.....</b>	<b>II</b>
<b>Abstract.....</b>	<b>III</b>
<b>Table of Contents .....</b>	<b>V</b>
<b>List of Tables .....</b>	<b>VIII</b>
<b>List of Figures.....</b>	<b>XII</b>
<b>Abbreviations .....</b>	<b>XIII</b>
<b>CHAPTER 1: Introduction .....</b>	<b>1</b>
1.1    ELECTRICITY GENERATION IN AUSTRALIA .....	4
1.2    ELECTRICITY GENERATION IN NSW.....	8
1.3    EXISTING DECISION MAKING FRAMEWORK FOR POWER PROJECTS IN NSW	11
1.4    PROBLEM STATEMENT .....	16
1.5    RESEARCH OBJECTIVES .....	19
1.5.1    Main Objective .....	19
1.5.2    Specific Objectives .....	19
1.6    RESEARCH SCOPE .....	20
1.7    METHODOLOGY .....	20
1.7.1    Literature Review .....	20
1.7.2    Scenario Analysis .....	21
1.7.3    Sustainability Impact Assessment and Multi-Attribute Decision Analysis (MADA).....	21
1.8    RESEARCH FRAMEWORK.....	23
1.9    DATA CONSIDERATIONS .....	24
1.10    RESEARCH SIGNIFICANCE .....	25
1.11    STRUCTURE OF THE THESIS.....	26
<b>CHAPTER 2: The Electricity Industry in NSW - A Historical Review .....</b>	<b>27</b>
2.1    EARLY YEARS (1886 TO 1949).....	27
2.1.1    Electricity Industry Overview .....	30
2.1.2    Ownership: Mixture of Public and Private.....	37
2.1.3    Electricity Consumption and Generation Outlook.....	38
2.1.4    Electricity Generation Investments .....	41
2.1.5    Electricity Generation Investments: Decision Framework .....	46
2.2    PUBLIC MONOPOLY (1949 TO 1995).....	47
2.2.1    Electricity Industry Overview .....	47
2.2.2    Ownership: Publicly Owned.....	51

2.2.3	<i>Electricity Consumption and Generation Outlook</i> .....	52
2.2.4	<i>Electricity Generation Investments</i> .....	54
2.2.5	<i>Electricity Generation Investments: Decision Framework</i> .....	57
2.3	MARKET REFORMS (1995 TO 2012) .....	61
2.3.1	<i>Electricity Industry Overview</i> .....	64
2.3.2	<i>Ownership: Mixture of Public and Private Owned</i> .....	78
2.3.3	<i>Electricity Consumption and Generation Outlook</i> .....	78
2.3.4	<i>Electricity Generation Investments</i> .....	80
2.3.5	<i>Electricity Generation Investments: Decision Framework</i> .....	83
2.4	FUTURE TRENDS .....	92
2.4.1	<i>Electricity Demand and Generation Outlook</i> .....	92
2.4.2	<i>Electricity Generation Investments</i> .....	94
2.5	SUSTAINABLE DEVELOPMENT AND ENERGY .....	100
2.6	CONCLUSION.....	101
<b>CHAPTER 3: Review of Power Project Decision Making Studies.....</b>		<b>105</b>
3.1	METHODS FOR ASSESSMENT OF POWER PLANT PROJECTS .....	106
3.1.1	<i>Single criterion assessments</i> .....	106
3.1.2	<i>Life Cycle Assessment (LCA)</i> .....	107
3.1.3	<i>Impact Pathway Approach</i> .....	109
3.1.4	<i>Cost-benefit analysis (CBA)</i> .....	110
3.1.5	<i>Multi - Criteria Decision Analysis (MCDA)</i> .....	111
3.2	REVIEW OF CRITERIA/INDICATORS IN MCDA STUDIES .....	122
3.2.1	<i>Literature review from international reports</i> .....	123
3.2.2	<i>Literature review from national studies</i> .....	125
3.2.3	<i>Some further literature review</i> .....	137
3.3	ESTABLISHMENT OF ATTRIBUTES (CRITERIA/INDICATORS).....	140
3.4	CONCLUSION.....	142
<b>CHAPTER 4: Development of Multi Attribute Decision Making Framework</b>		<b>145</b>
4.1	DESCRIPTION OF THE DECISION FRAMEWORK.....	147
4.2	IMPACT ASSESSMENT.....	157
4.2.1	<i>Economic Attributes</i> .....	159
4.2.2	<i>Environmental Attributes</i> .....	160
4.2.3	<i>Technical Attributes</i> .....	166
4.2.4	<i>Social Attributes</i> .....	167
4.2.5	<i>Impact Matrix</i> .....	170
4.3	MULTI-ATTRIBUTE DECISION ANALYSIS (MADA) .....	181
4.3.1	<i>Linear Value Functions</i> .....	182
4.3.2	<i>Constructing the hierarchy tree for criteria and sub-criteria</i> .....	189
4.3.3	<i>Weights: Pair-wise comparisons</i> .....	190
4.3.4	<i>Ranking of Alternatives: Total Values</i> .....	205

4.4	CONCLUSION.....	219
<b>CHAPTER 5: Conclusion and Recommendations for Future Research .....</b>		<b>223</b>
5.1	RESEARCH OBJECTIVE .....	223
5.2	RESEARCH METHODOLOGY .....	223
5.3	RECOMMENDATIONS FOR FUTURE RESEARCH .....	229
<b>References .....</b>		<b>231</b>
<b>APPENDIXES .....</b>		<b>249</b>
7.1	APPENDIX 1: ANALYSIS OF SUITABILITY OF COLLECTED CRITERIA/ INDICATORS IN NSW CONTEXT .....	249
7.2	APPENDIX 2: SCENARIO DEVELOPMENT .....	261
7.3	APPENDIX 3: IMPACT ASSESSMENT .....	263
7.4	APPENDIX 4: TOTAL LINEAR VALUES .....	285
7.5	APPENDIX 5: PAIR-WISE COMPARISON MATRIXES .....	287
7.6	APPENDIX 6: TOTAL VALUE CALCULATION .....	327



## List of Tables

Table 1.1	Capacity factors of electricity generation technologies .....	3
Table 1.2	Electricity generation, by state and territory (GWh) .....	10
Table 1.3	Agencies and Criteria involved in EIS of wind farm projects .....	13
Table 2.1	Institutional Involvement in NSW till 1950 .....	36
Table 2.2	Electricity Connected Properties in NSW (1947) .....	40
Table 2.3	Industrial electric powered equipment use until 1950 .....	40
Table 2.4	Power Plants Operating in NSW in 1949 .....	45
Table 2.5	Institution Involvement between 1950 and 1995 .....	51
Table 2.6	Electricity Consumption in NSW from 1955 to 1994 (GWh) .....	53
Table 2.7	Installed Electricity Generation by Plant Type (MW) .....	54
Table 2.8	Power Plant Investments from 1950 to 1995 .....	56
Table 2.9	Major changes in the NSW planning system since 1979 .....	58
Table 2.10	Time frame of power project completion .....	60
Table 2.11	Sold Retail Businesses .....	75
Table 2.12	Sold Gentrader Bundles .....	75
Table 2.13	Sold Development Sites .....	75
Table 2.14	Electricity Consumption by Sectors in 2001 and 2011 (GWh) .....	78
Table 2.15	Electricity Consumers in NSW between 1995 and 2011 .....	79
Table 2.16	Existing Principal (Scheduled and Semi-scheduled) Power Plants in NSW .....	81
Table 2.17	The Number of the Proposed Projects by Fuel Type .....	83
Table 2.18	Major changes since 1995 in the NSW planning system relevant to power plant project assessments .....	84
Table 2.19	Director General's Requirements which need to be addressed in EIS ...	89
Table 2.20	Electricity generation, by state and territory (TWh) .....	94
Table 2.21	Proposed power projects .....	96
Table 2.22	Findings of electricity generation review of NSW .....	102
Table 3.1	Decision matrix .....	114
Table 3.2	Pair-wise comparison matrix of AHP .....	119
Table 3.3	Summary of sustainable decision making studies by international organisations .....	123
Table 3.4	Criteria and indicators used in enhanced electricity system analysis for decision making .....	124
Table 3.5	Criteria and indicators used in nuclear energy in a sustainable development perspective .....	125
Table 3.6	Summary of criteria and indicators identified in specific country .....	126
Table 3.7	Criteria and indicators used for the study on sustainability of electricity supply technologies under German conditions .....	127

Table 3.8	Findings of Sustainability of Electricity Supply Technologies under German Conditions .....	128
Table 3.9	Criteria and indicators used for the study on sustainability assessment of electricity supply technologies for Switzerland .....	129
Table 3.10	Criteria and indicators used for the China Energy Technology Program (CETP) study .....	131
Table 3.11	Criteria and indicators used for Project Ranking in the Armenian Energy Sector .....	133
Table 3.12	Criteria and indicators used in NEEDS Project .....	135
Table 3.13	Criteria and indicators used in Mexico study .....	136
Table 3.14	Summary of Criteria and Indicators identified in journal articles .....	137
Table 3.15	Main differences among MCDM methods .....	143
Table 3.16	Selected attributes for MCDM analysis of power projects in NSW .....	144
Table 4.1	Environmental impact attributes .....	149
Table 4.2	Technological attributes .....	149
Table 4.3	Social impact attributes .....	150
Table 4.4	Main characteristics of selected electricity generation technologies ....	152
Table 4.5	Scenario description for the year 2035 .....	155
Table 4.6	Scenario description for the year 2050 .....	156
Table 4.7	Descriptions of attributes considered in this research .....	158
Table 4.8	Comparison of levelised costs of electricity generation (A\$/MWh) ..	160
Table 4.9	Levelised costs of hydro electricity generation (A\$/MWh) .....	160
Table 4.10	Land use for power technologies .....	161
Table 4.11	CO <sub>2</sub> emissions of power technologies .....	162
Table 4.12	Total waste of power technologies .....	163
Table 4.13	Air pollution from power technologies .....	163
Table 4.14	Noise emissions of power technologies .....	164
Table 4.15	Visual impacts of power technologies .....	165
Table 4.16	Water consumption of power technologies .....	165
Table 4.17	Resource use of power technologies .....	166
Table 4.18	Maturity of power technologies .....	167
Table 4.19	Job opportunities of power technologies .....	167
Table 4.20	Expected fatalities of power technologies .....	168
Table 4.21	Political acceptance of power technologies in NSW .....	169
Table 4.22	Social acceptance of power technologies .....	170
Table 4.23	Raw values of impacts of selected technologies .....	171
Table 4.24	Impacts of alternative scenarios .....	174
Table 4.25	Equations of linear value functions .....	183
Table 4.26	Linear values of alternatives .....	188
Table 4.27	Backgrounds of Delphi participants .....	192
Table 4.28	Scale preferences used in pair-wise ranking of attributes .....	193
Table 4.29	Pair-wise comparison- an example .....	194

Table 4.30	Pair-wise comparison matrix of expert 1 .....	196
Table 4.31	Pair-wise comparison matrix of expert 2 .....	197
Table 4.32	Pair-wise comparison matrix of expert 3 .....	198
Table 4.33	Pair-wise comparison matrix of expert 4 .....	199
Table 4.34	Normalised matrix of expert 1 .....	200
Table 4.35	Normalised matrix of expert 2 .....	201
Table 4.36	Normalised matrix of expert 3 .....	202
Table 4.37	Normalised matrix of expert 4 .....	203
Table 4.38	Consistency Ratios of pair-wise comparison values .....	204
Table 4.39	Weights of attributes .....	205
Table 4.40	Total values of alternatives for each expert .....	206
Table 6.1	Economic attributes used in the studies of power plant project assessments as in literature review .....	250
Table 6.2	Selected attribute for economic assessment of projects .....	251
Table 6.3	Environmental attributes used in the studies of power plant project assessments as in literature review .....	252
Table 6.4	Selected attributes for environmental assessment of projects .....	253
Table 6.5	Technical attribute used in the studies of power plant project assessments as in literature review .....	254
Table 6.6	Selected attributes for technical assessment of projects .....	257
Table 6.7	Social attributes used in the studies of power plant project assessments as in literature review .....	257
Table 6.8	Selected attributes for social assessment of projects .....	260
Table 6.9	Electricity generation, by state and territory (TWh) .....	261
Table 6.10	Calculation of generation output .....	262
Table 6.11	Impact assessment of current generation mix .....	263
Table 6.12	Impact assessment of Alternative-1 (BAU) for 2035 .....	265
Table 6.13	Impact assessment of Alternative-2 (MR-1) for 2035 .....	267
Table 6.14	Impact assessment of Alternative-3 (MR-2) for 2035 .....	269
Table 6.15	Impact assessment of Alternative-4 (HR-1) for 2035 .....	271
Table 6.16	Impact assessment of Alternative-5 (HR-2) for 2035 .....	273
Table 6.17	Impact assessment of Alternative-1 (BAU) for 2050 .....	275
Table 6.18	Impact assessment of Alternative-2 (MR-1) for 2050 .....	277
Table 6.19	Impact assessment of Alternative-3 (MR-2) for 2050 .....	279
Table 6.20	Impact assessment of Alternative-4 (HR-1) for 2050 .....	281
Table 6.21	Impact assessment of Alternative-5 (HR-2) for 2050 .....	283
Table 6.22	Total Linear Value Calculation for 2035 .....	285
Table 6.23	Total Linear Value Calculation for 2050 .....	286
Table 6.24	Attributes for Multi-Attribute Decision Making Framework for NSW's power projects .....	288
Table 6.25	Pair-wise comparison matrix .....	289
Table 6.26	Legend for pair wise ranking of attributes .....	289

Table 6.27	Example matrix .....	290
Table 6.28	Pair-wise Comparison Matrix of Decision Maker-1 .....	291
Table 6.29	Pair-wise Comparison Matrix of Decision Maker-2 .....	300
Table 6.30	Pair-wise Comparison Matrix of Decision Maker-3 .....	309
Table 6.31	Pair-wise Comparison Matrix of Decision Maker-4 .....	318
Table 6.32	Linear values of alternatives and weight values of attributes .....	327
Table 6.33	Total value calculation for Decision Maker - 1 .....	328
Table 6.34	Total value calculation for Decision Maker - 2 .....	329
Table 6.35	Total value calculation for Decision Maker - 3 .....	330
Table 6.36	Total value calculation for Decision Maker - 4 .....	331
Table 6.37	Comparison of total utility values of decision makers.....	332

## List of Figures

Figure 1.1	Australian electricity generation by fuel type for 2011-2012 (%).....	6
Figure 1.2	Australian electricity generation by fuel type (years).....	7
Figure 1.3	Australian electricity generation by fuel type (years-%).....	7
Figure 1.4	Electricity Generation by Source.....	9
Figure 1.5	Current Decision Making Framework for Power Projects .....	15
Figure 1.6	Regulated vs. Deregulated Electricity Generation Market.....	17
Figure 2.1	Maximum Electricity Demand .....	40
Figure 2.2	Electricity generation capacities of NSW by fuel type in 1949.....	41
Figure 2.3	Electricity Industry in NSW in 1989 .....	52
Figure 2.4	Electricity Consumption by Sectors in NSW in 1994 .....	53
Figure 2.5	The organisational structure of ECNSW .....	59
Figure 2.6	Electricity industry after market reforms.....	66
Figure 2.7	Electricity industry in NSW in 2012 .....	77
Figure 2.8	Principal generation by fuel type in 2011 .....	79
Figure 2.9	Installed capacity in NSW by fuel type .....	82
Figure 2.10	Legislations relevant to power projects in NSW during the EIS.....	91
Figure 2.11	Summer maximum demand projections for NSW.....	92
Figure 2.12	Winter maximum demand projections for NSW .....	93
Figure 2.13	Principal Generation Capacity by fuel source from 1996 to 2012 .....	95
Figure 2.14	Generation Capacities of Proposed Projects.....	95
Figure 3.1	Life Cycle Assessment Framework .....	108
Figure 3.2	Key steps in the cost-benefit process.....	111
Figure 3.3	The MCDA Process.....	112
Figure 3.4	Multi-criteria decision making methods.....	115
Figure 3.5	AHP decision structure .....	120
Figure 4.1	AHP-based decision support framework.....	147
Figure 4.2	Share of electricity generation by technology in 2011 in NSW .....	151
Figure 4.3	Share of installed capacity by technology in 2011 in NSW .....	153
Figure 4.4	Generation-mix alternatives for five scenarios in 2035 and 2050.....	157
Figure 4.5	Linear value diagrams of attributes for the years 2035 and 2050.....	185
Figure 4.6	AHP hierarchy tree for decision making of power projects .....	190
Figure 4.7	Delphi process for assessing impacts of power projects .....	193
Figure 4.8	Overall scores for expert 1 .....	207
Figure 4.9	Overall scores for expert 2.....	210
Figure 4.10	Overall scores for expert 3.....	213
Figure 4.11	Overall scores for expert 4.....	216

## Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AETA	Australian Energy Technology Assessment
AGL	Australian Gas Light Company
AHP	Analytical Hierarchy Process
AIRP	Air Pollution
APH	Parliament of Australia
ARENA	Australian Renewable Energy Agency
AWEO	Australian Wind Energy Association
BAU	Base as Usual Scenario
BREE	Bureau of Agricultural and Resource Economics
CBA	Cost Benefit Analysis
CC	Combined cycle
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Sequestration
CEF	Clean Energy Future
CEFC	Clean Energy Finance Corporation
CETP	China Energy Technology Program
CIEGPNSW	Commission of Inquiry into Electricity Generation Planning in NSW
CO <sub>2</sub>	Carbon Dioxide
COAG	Council of Australian Governments
CPRS	Carbon Pollution Reduction Scheme
CR	Consistency Ratio
CSM	Coal Seam Methane
DALY	Disability adjusted life years
DCCEE	Department of Climate Change and Energy Efficiency
DECCW	Department of Environment, Climate Change and Water
DGRs	Director General's Assessment Requirements
DLG	Department of Local Government
DME	Department of Minerals and Energy
DoE	Department of Energy
DoP	Department of Planning
DoPI	Department of Planning and Investment
DPI	Department of Primary Industries
EAC	Electricity Advisory Committee
EANSW	Electricity Authority of New South Wales
ECNSW	Electricity Commission of NSW
EIA	Energy Information Administration (US)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement

ELPSC	Electric Light and Power Supply Corporation
EnANSW	Energy Authority of NSW
EP& A	Environmental Planning and Assessment
EPA	Environment Protection Authority
ESAA	Electricity Supply Association of Australia
ESD	Ecologically Sustainable Development
ESDSC	Ecologically Sustainable Development Steering Committee
ETF	Energy Task Force
g	Gram
GDP	Gross Domestic Product
GGAS	Greenhouse Gas Reduction Scheme
GHG	Greenhouse Gas
GWh	Gigawatt-hour
HR	High Renewables Scenario
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IPART	Independent Pricing and Regulatory Tribunal
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
JOCR	Job Creation
kg	Kilogram
kl	Kilolitre
kWh	Kilowatt-hour
LAUS	Land Use
LCA	Life Cycle Assessment
LCOE	Levelised Cost of Electricity
LEPs	Local Environmental Policies
LRET	Large-scale Renewable Energy Target
MADA	Multi Attribute Decision Analysis
MADM	Multi Attribute Decision Making
MCDA	Multi Criteria Decision Analysis
MODM	Multi-Objective Decision Making
MR	Moderate Renewables Scenario
MRET	Mandatory Renewable Energy Target
MURAME	Multi-criteria Ranking Method
MW	Megawatt
MWh	Megawatt-hour
NEA	Nuclear Energy Agency
NEEDS	New Energy Externalities Developments for Sustainability
NEL	National Electricity Law
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NER	National Electricity Rules
NGMC	National Grid Management Council
NOx	Nitrogen Oxides
NOIS	Noise Impact
NPV	Net Present Value

NRET	NSW Renewable Energy Target
NSC	National Sustainability Council
NSW	New South Wales
OCGT	Open Cycle Gas Turbine
OECD	Organisation for Economic Co-operation and Development
PAC	Planning Assessment Commission
PAOP	Political acceptance of the project
PDF	Potentially Damaged Fraction
POE	Probability of Exceedence
PV	Photovoltaic
PWD	Public Works Department
QGCPPO	Queensland Government Chief Procurement Office
RA	Risk Assessment
RD	Railway Department
REC	Renewable Energy Certificate
RET	Renewable Energy Target
RUFU	Resource Use-Fuel
SAOP	Social acceptance of the project
SCC	Sydney County Council
SCER	Standing Council on Energy and Resources
SEAC	Severe Accidents (Fatalities)
SEPPs	State Environmental Planning Policies
SES	Southern Electricity Supply
SFP	Solar Flagships Program
SMC	Sydney Municipal Council
SMHEA	Snowy Mountains Hydro-Electric Authority
SO <sub>x</sub>	Sulphur Dioxide
SOC	State-owned Corporation
SRES	Small-scale Renewable Energy Scheme
SSD	State Significant Development
TEMA	Technological Maturity
TOWA	Total Waste
TWh	Terra Watt-hour
UN	United Nations
VIC	State of Victoria
VISU	Visual Impacts
WACO	Water consumption
WCED	World Commission on Environment and Development
WNA	World Nuclear Agency
WWI	World War I
WWII	World War II
YOLL	Years of Life Lost